

LITTORAL SUBSONIC SEISMOACOUSTIC PHENOMENA ULTRASONIC MODELING: PART 1

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Award Number: N00014-97-C-0065

Category: Shallow-Water Seismoacoustics

LONG-TERM GOALS

Develop comprehensive physical understanding of fundamental littoral seismoacoustic phenomena on the interaction of transient underwater acoustic waves and interface Scholte waves with ocean bottom heterogeneities and topography.

OBJECTIVES

Characterize subsonic seismoacoustic phenomena associated with the interaction of near-grazing transient underwater acoustic waves and interface Scholte waves with heterogeneities and periodic topographical features such as sand ripples with at least one dimension comparable to the wavelength.

APPROACH

Use ultrasonic modeling techniques developed by the Principal Investigator (J. R. Chamuel) between 1979 and 1996 to obtain qualitative and quantitative experimental results characterizing frequency-dependent effects of periodic liquid/solid interfaces on Scholte wave dispersion, conversion, backscattering, and attenuation. These ultrasonic modeling techniques proved to be cost-effective powerful versatile tools complementing numerical methods and field experiments by providing physical insight into complex wave phenomena [1-6].

WORK COMPLETED

Carried out studies on Scholte wave dispersion along rippled liquid/solid interfaces.

RESULTS

Obtained quantitative results characterizing the dispersion of Scholte waves propagating along a rippled surface of an immersed "soft" solid half-space. The findings reveal that a rippled "soft" liquid/solid interface can decrease the velocity of high-frequency Scholte wave components propagating normal to the ripples by more than 70% . The results will be presented at the 16th International Congress on Acoustics and the 135th Meeting of the Acoustical Society of America, Seattle, June 1998.

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 30 SEP 1997		2. REPORT TYPE		3. DATES COVERED 00-00-1997 to 00-00-1997	
4. TITLE AND SUBTITLE Littoral Subsonic Seismoacoustic Phenomena Ultrasonic Modeling: Part 1				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Sonoquest Advanced Ultrasonics Research,PO Box 81153,Wellesley Hills,MA,02181-0001				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 3	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

IMPACT/APPLICATIONS

The new findings have implications regarding the interpretation of underwater seismoacoustic field data and the corresponding geoacoustic inversion based on Scholte waves characteristics in the presence of periodic/random topographical features. The research outcome will help interpret seismoacoustic field data, determine the physical properties and structure of ocean boundaries, predict and utilize ambient noise, improve acoustic detection of buried objects, determine seismoacoustic limitations on the penetration of transient pressure waves into sediments, link ocean bottom variability with seismoacoustic variability, develop real-time littoral simulation capabilities, and validate numerical models. Liquid/solid seismoacoustic phenomena play a major role in many other applications such as acoustic silencing, hydroacoustic nuclear test monitoring, bathymetric mapping, nondestructive testing, borehole geophysics, ultrasonic imaging, and lithotripsy.

TRANSITIONS

The new findings will have a direct impact on future underwater field experiments and data interpretation in view of the potential importance of sediment topography on Scholte wave dispersion.

RELATED PROJECTS

The work relates to ONR sponsored research activities conducted by several scientists in the following areas:

- Rough interface scattering (Eric Thorsos, H. Schmidt, A. Ivakin, D. Jackson, and K. Williams)
- Ocean bottom penetration and scattering (D. R. Jackson, K. Smith, S. Rajan, T. Yamamoto, Chotiros, and R. Stephen).
- Geoacoustic inversion (N. Ross Chapman, G. B. Deane, A. Tolstoy, S. Johnson and J. Wiskin).
- Detection of buried objects using interface waves (T. Muir and E. Smith).

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